



## PIER Energy System Integration Program Area

### Secondary Distribution Impacts of Residential EV Charging

**Contract #:** 500-98-059

**Contractor:** Georgia Technology Research Corporation

**Contract Amount:** \$100,000

**Contractor Project Manager:** Frank Lambert (404) 675-1855

**Commission Contract Manager:** Mark Rawson (916) 654-4671

**Status:** Completed

#### **Project Description:**

The purpose of this contract is to cost share a collaborative project to analyze the power quality impacts of large single-phase residential loads, such as electric vehicle chargers, computer equipment, appliances, and HVAC to residential secondary distribution (customer-side) systems.

The market penetration of these large single-phase residential loads is a concern to distribution utilities, electric power providers and consumers alike. To the power providers, it is a potential power quality, power delivery, and energy consumption concern. For the distribution utilities and consumers, it is a concern in terms of distribution system reliability, house or site electrical system reliability, and energy costs. Impacts of consumer appliances on the utility secondary distribution system are network externalities. Electricity providers have no regulatory responsibility for network externalities. However, electricity providers do recognize the importance of this issue and are cost sharing this project. The collaborative includes Southern California Edison, Pacific Gas and Electric, Sacramento Municipal Utility District, Virginia Power, Southern Company, and Florida Light and Power.

#### **This project supports the PIER Program objective of:**

- Improving the reliability/quality and efficiency of California's electrical transmission, distribution and delivery grid by addressing power quality, power delivery, and energy consumption concerns.

#### **Proposed Outcome:**

- Analyze the power quality impacts of large single-phase residential loads, such as electric vehicle chargers, computer equipment, appliances, and HVAC to residential secondary distribution (customer-side) systems.

#### **Actual Outcomes:**

The main conclusions of the project based upon utility systems and chargers investigated were:

1. Commercial light-duty on-road EV chargers engineered to National Electric Vehicle Infrastructure Working Council (IWC) guidelines based upon IEC 1000-3-4 do not give rise to excessive voltage total harmonic distortion (THD) on the secondary side of the transformer. Two critical elements that make these guidelines effective are a minimum total power factor of 95 percent and a maximum current THD of equal to or less than 20 percent.
2. The main cause of concern is the overloading of the distribution transformer with widespread use of EV chargers, assuming the chargers meet voluntary IWC guidelines such that voltage THD is not an issue. Still, utility service planning groups should ask for kVa and true power factor values in addition to the kW values for any rectifier or other non-linear load.

**Project Status:**

Interim results of this project have been presented and published at the North American Electric Vehicle Infrastructure conference in November 1999. A final report was presented at the Electric Vehicle Symposium in October 2000. Project results have also been provided to the IEEE Task Force on Single Phase Harmonics and a summary provided to EPRI for release to the IWC.